The Effects of Improved Land Rights on Land Markets, Land Use Efficiency, Employment and Household Welfare: Evidence from the 2013 Vietnam Land Law

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Abstract: This paper investigates the impact of increased tenure security on land transactions and the ensuing productive efficiency, as well as its spillover effects on the labor market and overall household welfare. Vietnam's 2013 Land Law, which extends the lease term for usufruct rights for annual land from 20 years to 50 years, provides the opportunity for difference-in-differences (DID) identification. This involves the first difference between annual land and perennial land, and the second difference between before and after the law was passed, to study the effect of increased land security. Plot-level data are available for the land transfer outcomes (lease out, lease in, sold, purchased). For the welfare outcomes, the impacts of the land law are estimated at the household level. Household outcomes include the household's food expenditure per capita as well as indicator variables regarding labor (wage labor, nonfarm wage labor, wage labor in agriculture, wage labor in commune, wage labor in province, and wage labor outside of province), and whether households have their own business. Plot-level DID results reveal that annual plots are 3 (or 6) percentage points more likely to be leased out (or sold) as a consequence of the law, while there is no significant effect on the likelihood of annual plots being leased in or purchased. This result is in line with the expectation that the heightened security generated by the law is a supply factor affecting the supply of land. As both rental and sale markets are found to transfer land from less productive to more productive farmers, the more active land markets incentivized by the law are expected to enhance land use efficiency. Household-level analysis shows that the passage of the law is associated with a shift from self-employed farm work to wage employment, especially agriculture-related wage work that is closer to home. Household food expenditures per capita are also found to increase due to the law. Given these findings, the study suggests that the law can be a low-cost tool in increasing land market participation with some effects on the labor market and improving welfare.

Key Words: 2013 Vietnam Land Law, Land Rental Market, Land Sale's Market, Efficiency, Welfare.

1. Introduction

Land holds a distinct and precious value as a finite resource essential to agricultural production. As such, the functionality of land markets is crucial in driving agricultural productivity and fostering economic growth. A well-functioning land rental market serves as a valuable mechanism for correcting misallocation and improving agricultural productivity (Ayerst et al. 2020; Deininger 2003; Deininger and Jin 2005; Jin and Deininger 2009; Chen, Restuccia, and Santaeulàlia-Llopis 2023; Chamberlain and Ricker-Gilbert 2016). Additionally, the land rental market is effective in improving household income (Jin and Jayne 2013; Zhang et al. 2018; Xu and Du 2022), combating poverty (Ghebru and Holden 2019; Seewald, Baerthel, and Nguyen 2023; de Janvry 2001) and addressing food insecurity (Muraoka, Jin, and Jayne 2018). Furthermore, the effects of the land rental market extend to labor choices and structural transformation, facilitating youth employment and migration (Ricker-Gilbert and Chamberlain 2018; Kosec et al. 2018), thus fostering overall economic growth and transformation (Deininger 2003; Jin and Deininger 2009).

However, the land rental markets in the developing world exhibit significant imperfections. Drawing from survey data on actual rental and willingness to rent in rural China, Deininger and Jin (2005) found substantial disparities between real and potential participation in land rental, as well as between the actual and desired land rental quantities. Other studies have revealed that farmers are unable to fully adjust their desired amount of land for cultivation through the existing land rental market mechanisms (Deininger, Ali, and Alemu, 2008; Rie, Jin, and Jayne 2018; Ricker-Gilbert and Chamberlain 2018). Market constraints are a ubiquitous reality across most developing countries. Legal restrictions directly impact the market in certain instances. For example, in Ethiopia, regulations stipulate that no more than half of a farm can be rented out (Ghebru and Holden 2019). Similarly, in China, until recently, rural land could not be rented out

to non-villagers without permission from village leaders in many villages (Brandt et al. 2002). Moreover, in India, Deininger, Jin, and Nagarajan (2008) found that tenancy reform had adverse effects on land rental.

Tenure insecurity is a prevalent hindrance to the functioning of the land rental market. In some tenure systems, land rights are not guaranteed. In China and Vietnam, where land is subject to state ownership and only usufruct rights are granted to holders, the land is at risk of being appropriated for reallocation without sufficient compensation. Well-defined land rights are vital to the ability and willingness of farmers to invest and use the valued asset efficiently (Holden et al. 2010; Abdulai et al. 2011; Lawry et al. 2017; Bellemare et al. 2020). In the absence of secure land rights, confidence in renting land is often hampered (Deininger and Jin 2008). As a result, ill-defined tenure perpetuates land misallocation and truncates productivity with inefficient use of land and other resources (Ayerst et al. 2020; Chen et al. 2022).

Given the significant impacts of land rentals on economic efficiency and farmers' livelihoods, considerable research effort has been directed toward studying effective ways to improve tenure security. A large number of studies examining impacts of land titling programs in Asia, Africa and the former Soviet Bloc have shown positive effects of land titling on long-term investments, land values, and market participation (Ali and Deininger 2022; Brandt et al. 2017; Crewett and Korf, 2008; Do and Iyer, 2003 and 2008; Deininger, Ali, and Alemu 2011; Deininger and Jin 2005; Gao, Shi, and Fang 2021; Galiani and Ernesto 2010; Barajas 2023; Sitko, Chamberlin, and Hichaambwa 2014; Jacoby, Hanan and Minten 2017; Zhou, Cheng, and Zhang 2022).

However, compared to the large literature on the effects of land titling programs, there have been relatively few studies on the effects of land certification without titling or the passage of land laws,

with few exceptions (Deininger and Jin 2009; Holden, Deininger, and Ghebru 2010; Deininger, Ali, and Yamano 2008; Bellemare et al. 2020). The limited attention given to the economic impacts of the passage of laws and regulations is surprising and unjustified, especially considering the potential cost-effectiveness of implementing land laws and policies relative to the expenses associated with land titling programs.

Ever since the privatization and marketization of Doi Moi in the late 1980s, the land market in Vietnam have been the topic of much research interest due to its history and evolution. Many papers have been published on the land market in Vietnam and a few on the impacts of its different versions of land law. Do and Iyer (2008) find that the additional rights granted to landholders by the 1993 land law increase land share for long-term crops and lead to more labor supply in nonfarm activities. Hansen (2013) discusses the implications of the 2013 land law on land appropriation. Deininger and Jin (2008) identified the existence of significant transaction costs associated with the land rental and land sales market despite the improved land rights in the early stage of the reform.

This paper builds on the rich existing literature in the fields of tenure security and land transfers and contributes to filling a gap at their intersection with the focus on land law. It aims to estimate the causal effect of tenure security in response to the passage of the 2013 land law in Vietnam on land transfers and other economic outcomes. The paper employs a difference-in-differences model to evaluate the impacts of the land law. Particularly, the law extends the land lease term for annual land from 20 years to 50 years, immediately affecting leases that were going to expire in October 2013 under the older version of the law. By comparing the treatment group (annual land) to the control group (perennial land) across time periods before and after the law's enactment, the study adopts a cleaner identification strategy than previous studies for assessing the effects of the law.

This paper adopts a similar approach to Bellemare et al. (2020), utilizing a difference-in-differences framework and employing the same policy instrument. In their study, Bellemare et al. (2020) find that improvement in tenure security on annual plots increases the likelihood of investment in irrigation technology for soil and water conservation. In this paper, we aim to gain insights into the multifaceted implications of tenure security improvements. More specifically, the impact measures in this study include farmers' participation in the land rental and sales markets, efficiency of the land markets, labor employment, and household welfare.

In summary, our findings indicate that the law indeed increases households' confidence in renting out and selling their land, while having little effect on the demand side of the rental and sales markets. This reinforces the tenure security effect of the passage of the land law on land transfers. The study also utilizes data on annual crop production to examine the law's facilitating power on the land markets' efficiency in allocating land. We find that while the land markets are distributing land from households with lower farming ability to those with higher farming ability, the law which had positive effects on farmers' participation in land rental and land sales also contributes to additional efficiency improvement of the land markets. Additional analysis at the household level reveals that the passage of the land law for annual land tends to shift labor away from own farm work to wage work, especially in local agricultural sectors. Our analysis also reveals evidence supporting the association between the passage of the land law and higher household expenditure.

This paper makes two contributions. First, it expands the literature on tenure security by focusing on the impacts of the passage of a land law, an aspect that has been rarely studied despite the obvious cost advantage of passing a land law than implementing a land titling program. The findings of this study are likely to have far reaching implications for future land policy in Vietnam and other developing countries planning to strengthen land tenure security through alternative

options of enacting a land law versus implementing land titling programs. This paper also makes a methodological contribution by employing the difference-in-differences (DID) estimation model to identify the effect of the land law on farmers' rental decisions. A review of the literature reveals that ordinary least squares (OLS) and probit/logit models are the most common methods used in the studies of land rental market participation. The unique nature of the land law in Vietnam that only affects annual land but not the perennial land provides the opportunity to apply rigorous DID methods. Hence, the findings from this rigorous identification strategy are more informative in guiding future policies.

The next section introduces the context of land rights and land markets in Vietnam and provides an explanation of why it is a suitable place to study tenure security. Section 3 formulates a conceptual framework for hypotheses that can be tested in the following sections. Section 4 presents the data and how it is used in this study. Section 5 presents the empirical strategies for the main identification of the impact of the law on land transactions, labor outcomes, and household expenditures on food. The results are discussed in section 6. Section 7 further discusses the implications of the law on land allocative efficiency in Vietnam. Finally, section 8 concludes with policy implications.

2. Contextual background

In Vietnam, land technically belongs to the entire people and is managed by the state, which allocates and leases land use rights to individuals. Since the enactment of the first land law in 1988, multiple updates have been introduced, aiming to clarify definitions, and enhance existing land rights. Each revision is intended to fill in the gaps and improve upon previous laws. Notably,

between 1988 and 1993, when the second land law was enacted, there was no established market for land use rights.

In 1993, land use rights were defined as the rights to exchange, transfer, inheritance, lease, and mortgage. By the time the next version of the land law came out in 2003, these rights were expanded to include five additional rights, namely subleasing, granting, securing as collateral, employing as a form of capital, and claiming compensation. Under the 1993 law, plots of land allocated to renters were assigned a designated purpose of use, falling into categories such as residual land, water surface land, forestry land, grassland/pasture, and various types of agricultural land. Each agricultural type has its own terms of lease. Agricultural land designated for growing perennial crops had a lease term of 50 years, while annual crop land was only leased for 20 years. Nearing the end of a lease term, the law allowed the usufruct holder to apply to have the lease extended if they wish. To switch to a different purpose of use, the usufruct holders must have filed a legal case to ask for permission from various levels of the People's Committee, which was a complicated and time-costly process.

This paper specifically focuses on investigating changes introduced in the 2013 land law. The 2013 land law revised the lease term for annual crop land to 50 years and took automatic effect. This would not only reestablish the rights to use these annual land plots *en masse* at no extra bureaucratic costs but also reaffirm the overall confidence of land use right owners in renting out their land, and furthermore, recreate the market for land title exchange for annual plots whose certificate would have become void without applying for an extension (which, thanks to this new law, no one had to go through). Overall, the 2013 law enhanced tenure security for annual land use rights. Additionally, switching the purpose of use between annual and perennial plots no

longer required a legal declaration. Given the huge initial net benefit of the law, the land law has the potential to be a good cost-effective tool in the policy maker's arsenal.

A key focus of this paper is to study how this security manifests in the transactional markets with (selling-buying) and without (renting in-renting out) the exchange of land titles. The fact that the law only affects one type of land (annual arable land) but not the other types of arable land (e.g., perennial arable land) provides a unique setting to study the impact of improved tenure security due to the law on households' decisions regarding land transactions using a difference-in-differences approach.

3. Conceptual framework

In this section, we construct a simple household model of land rental to predict the potential effects of the passage of the 2013 Vietnamese Land Law on farmers' decisions regarding land rental. Assume a household is endowed with fixed amounts of land ($\overline{L}$), labor ($\overline{N}$), and an exogenously given level of agricultural ability (α), and consider an agricultural production function, denoted as $f(\alpha;\, L, N)$, with standard properties such as $f_\alpha > 0, f' > 0, f'' < 0$ with respect to all arguments, along with positive second-order cross-partial derivatives.

Given land price (r) and labor wage (w), households are further faced with transaction costs for both renting out land (TC^{Out}) and renting in land (TC^{In}). These transaction costs are associated with the level of land tenure security. Consequently, households make decisions regarding the amount of land to be rented out (L^{Out}), rented in (L^{In}), and labor supply outside of their own farm (N^{Out}), which could be negative if households are net hirers of labor) to maximize profit. Mathematically, a household's profit maximization problem is expressed as follows:

$$\underset{L^{Out},L^{In},N^{In}}{\text{Max}} pf\left(\alpha;\ \overline{L} - L^{Out} + L^{In}, \overline{N} - N^{Out}\ \right) + (r - TC^{Out})L^{Out} - (r + TC^{In})L^{In} + wN^{Out}$$

FOC: $pf_L = r - TC^{Out}$ or $pf_L = r + TC^{In}$ (1)

and $pf_N = w$

The first-order condition equations allow us to derive the comparative statics and propositions on a farmer's decision to participate in land rental in response to a change of transaction costs (in response to the passage of the 2013 Land Law) and a household's level of agricultural ability. Given that the passage of the 2013 Land Law aims to improve tenure security and transferability of annual arable land, the passage of the 2013 Land Law should be associated with the reduction of the transaction costs for renting out and in. The comparative statics analysis based on the first-order conditions derived in section A1 of the appendix allows us to derive the following propositions which can be tested empirically in the main body of the analysis.

Proposition 1: A reduction in the transaction cost to renting out (TC^{Out}) due to the passage of 2013 land law reduces net land rental and therefore increases the probability of leasing out.

Proposition 2: Holding everything else constant, the probability of renting in is unaffected by a reduction in renting out transaction cost (TC^{Out}). However, demand for land rental is also expected to increase due to the equilibrium effect as a result of a transaction cost reduction from the 2013 land law.

Proposition 3: The probability of supplying labor out from their own farm is increasing in the transaction cost to leasing out (TC^{Out}) and therefore the passage of the 2013 land law leads to a higher probability of hiring out labor from the farm.

Proposition 4: Household income is decreasing in the transaction cost of leasing out (TC^{Out}), therefore a reduction in the transaction cost of leasing out TC^{Out} due to the passage of 2013 land law improves income.

Proposition 5: The probability of renting in (out) land is strictly increasing (decreasing) in households' agricultural ability α.

In addition to farmers' decisions regarding land rental, we are also interested in investigating the impacts of the passage of the 2013 Land Law on farmers' participation in the land sales market. Although farmers' decisions regarding land sale/purchase are more complex due to considerations of maximizing land profit over its lifespan, it is intuitive to expect that the passage of the 2013 Land Law will also reduce transaction costs associated with land purchase and sale, thus increasing farmers' participation in these activities. Similarly, we anticipate that farmers with higher (lower) farming ability are more likely to lease in (out) land.

5. Data

This paper utilizes the Vietnam Access to Resources Household Survey (VARHS) data collected by the United Nations University World Institute for Development Economics Research (UNU WIDER). For this study, we employ data from three rounds (2008, 2010, and 2012) conducted before the land law was enacted in 2013, and two rounds (2014 and 2016) conducted after the law came into effect. The sample of households in the survey was first selected randomly in 2016 to represent the rural population in 12 provinces across all regions of Vietnam, providing an ideal context for comparing between annual and perennial land types. During this period from 2008-2016, the survey revisits the same households to collect data on household characteristics, land

activities, members' employment, and livelihood and food expenditure with additional households added in 2008 and 2016.

The study draws from 13,000 household observations over five rounds of data from 2,600 households. The highly balanced household panel data was selected to include only households that appear in all five waves of the survey and furthermore excludes households that are not active operators on either type of land in all five rounds. Household characteristics including head's gender, education, age, household size, and the logarithm of landholdings in 2008 are regressed on the dummy variable indicating whether household appears in all five rounds of data to determine whether there are significant differences between households surviving in all five rounds and those they are missing. Standard errors are clustered at the provincial level due to the sampling design being representative at the provincial level (Abadie et al. 2023). Table 2 reports that gender, education, age, and landholdings do not correlate with the survival rate. However, there is more annual land and household size is larger among those included in the balanced panel. The choice to exclude households that are non-operators in all five periods is to keep the focus of the study on active operating households.

The survey provides land transactional data at the plot level, comprising 54,428 plot observations, with 10% categorized as perennial land, and 90% as annual land. The imbalance between the treatment and control group sizes is compensated by a large total sample size, mitigating the concerns over losing statistical power. Over the years, 1,601 households reported owning and/or renting only annual land, 108 households owning and/or renting only perennial land, and 891 households working with both types of land.

The household characteristics associated with annual and perennial land exhibit statistically significant differences. Table 21 shows that, between households that work with or own annual land at some point and those that work with or own perennial land, annual plots are associated with smaller-sized households with lower values in durable goods. Additionally, annual plots are also more likely to be headed by female members than perennial plots, and the household heads tend to be younger with lower levels of education. Regarding land and crop management, annual plots are smaller than perennial plots and tend to be closer to home. However, the quality of both types of plots appears to be similar relative to the surrounding land in their communities, with the mean reported at “about average” by households for both types of land.

Table 3 provides a summary of the probability of land transfers over the years in both the rental and sales markets, for both the control perennial group and the treatment annual group. The sample shows statistically significant differences between transactional activities in the markets for the two groups of land. The difference is large in the rental market. The probability of annual plots being leased out and in is 5.4 and 2 percentage points higher than perennial plots. The rental market serves an important function in redistributing annual land. On the other hand, it is less clear which type of land is more active in the sales market. Nevertheless, the rate of participation is low with the percentage capped at one digit.

The survey reports employment by individual members in the households, as summarized in table 4, providing insights into the type of work households are engaged in. Managing their own farms remains the predominant type of work, as expected, but has shown a rapid decline. Starting from 98% of households in 2008, it steadily declined to 91% of households in 2016. Conversely, wage jobs have become another major source of income, and are increasing in importance, rising from accounting for barely over half of the households in 2008 to 67% in the final round of data.

Interestingly, in the period before the new land law, households engaged in off-farm jobs increased by 16 percentage points between 2008 and 2012, only to slightly reduce in the following years. In contrast, farm-related jobs were seen in less than 20% of households in the pre-law period but skyrocketed upwards, with 2016 showing a doubling of the fraction of households compared to eight years before. This raises questions about whether the law may not only affect the land market but also have an impact on labor distribution.

Not only are wage jobs more prominent; but specifically, households are more likely engaged in local work as opposed to working in another commune or migrating outside of the province entirely. By 2016, local jobs accounted for 75% of the households participating in the job market, almost doubling the number of households with members working farther away. Furthermore, while wage labor and wage labor both within the commune and within the province generally trend upwards, migrating outside of the province displays an interesting pattern, seeing a drastic decline between 2008 and 2012 before bouncing back up.

In table 4, we also present the frequency of households owning businesses as another source of income, which fluctuates within the range of 21-26% of the sampled households. The number of businesses owned by households is also examined but not reported. No noticeable trend is detected in either statistic. Additionally, food expenditures per capita in the last column are shown to steadily increase with the exception of 2014.

6. Econometric approach

6.1. Estimation of impacts on land transfer outcomes

An important feature of the 2013 law is that the law only applies to annual crop land but not the perennial crop land. This unique feature allows us to employ the difference-in-differences (DID) method to identify the impacts of the new land law on land transfer outcomes. Specifically, the first difference is the difference in transfer outcomes between the annual and perennial types of plots belonging to the same households, and the second difference is the difference between after and before the law is implemented. Mathematically, the DID specification can be expressed as follows:

$$y_{iht} = \beta_0 + \beta_1 TREAT_{iht} + \beta_2 T_t + \beta_3 (TREAT_{iht} \cdot POST_t) + \boldsymbol{\beta_4 Z_{iht}} + \sigma_h + \epsilon_{it} \quad (2)$$

where y_{iht} are transfer outcomes $\{\text{rented out}, \text{rented in}, \text{sold}, \text{purchased}\}$ of plot i in household h in year t, which is valued 1 if yes and 0 otherwise. $TREAT_{iht}$ is a dummy variable for annual-type plots. T_t is the year t fixed effect to control the overall trend in rental activities. $POST_t = 1$ for observations from years 2014 and 2016 after the law is implemented and 0 otherwise. $\boldsymbol{Z_{iht}}$ are plot and household characteristics including distance between plot and home, plot area, plot land quality, household head's gender, age, squared age, education, and household size. σ_h is household h fixed effect, ϵ_{iht} is the random error term with mean zero. The coefficient β_3 on the interaction term $TREAT_i \cdot POST_t$ provides the estimated effect of law treatment of tenure extension on land transfer outcomes. Estimation is done with ordinary least squares while clustering standard errors by communes.

6.2. Parallel trends assumption

The key underlying assumption for the DID regression in equation (1) to be valid is that the trend of land rental outcomes between the annual arable land and the perennial arable land would have

been the same in absence of the land law, therefore any difference in land transfer outcomes post-the law is due to the implementation of the law. Directly testing for this assumption is difficult due to the commonly known missing data problem. Instead, people tend to rely on historical data prior to the policy intervention to test whether the pre-trends between the treatment and control group are parallel. Here we follow this approach to perform the pre-trend test using data from the three pre-law rounds: 2008, 2010 and 2012.

Figure 1 provides a visual representation of the trends of land transactions at the means over the years between the control and treatment groups. The trends of leasing annual and perennial appear to be much more similar and parallel in the 2008-2012 periods, even as there is a slight diversion in 2012 right before the land rights would expire and the law was announced. Regarding the trend for selling and purchasing land, while the trends between the annual crop land and the perennial crop land is similar between the period from 2008 and 210, the annual crop land experienced noticeable drop in both sale and purchase despite the increased activity in perennial land transfers. As a result, the likelihood of land sale or purchase for annual land is 3-4% smaller than the perennial land and the difference is statistically significant. We posit that this sudden drop in land sale and purchase for annual crop land is related to the soon expiration of the land certificate for annual land; furthermore, the anticipated expiration effect is likely to have a more noticeable effect on farmers sale and purchase decisions than on their leasing decisions because land lease does not involve the change hand of land certificate.

As a diagnostic test for the parallel trend assumption, we estimate equation (1) using the restrictive sample to pre-treatment periods 2008-2012 with 2010 as the base, and then further restrict it to only 2008-2010. The parallel trends assumption holds if the null hypothesis for $\beta_3 = 0$ cannot be rejected. If, however, β_3 is statistically different from 0, then the assumption is invalid. Particularly,

if 2010 is statistically indifferent from 2008 but significantly differs from 2012, this would suggest that households did respond to an expectation of land certificate.

6.3.Parallel trends assumption testing

The results of these pre-trend tests are reported in table 5. The first pre-trend test was done with all three pre-law rounds of data making 2010 as the base for comparison. We see no statistical effect in 2008 for all four transfer activities and no effect in 2012 for renting out and renting in. However, the results show approximately 2.5 percentage point reduction in both purchase and sale of annual crop land (relative to perennial land) in 2012 with a 95 percent level of confidence. The negative trend may be explained by the uncertainty of land certificates because they will soon expire. The stark reduction in the sales market sharply points towards the effects of uncertainly and lack of tenure security. There are reasons that this declining trend is not detected in the leasing market. First, it does not involve an exchange of land certificate. The expiration very well could induce a loss of confidence in renting out land and limit the pool of potential renters. However, another reason to circumvent this issue is that leasing can be contracted in short terms and can be terminated by the owners and rentees before their land certificates expire.

Considering there is no reason for renting, selling, and purchasing activities of annual land to be affected between 2008 and 2010, it can be concluded that the parallel trends assumption holds between these two periods. In order to identify the law's impact, we exclude 2012 from the sample. An analysis with the full sample from 2008-2016 is performed and reported in the appendix, tables A3-A6.

6.4.Household ability and allocative effects estimation

The second empirical investigation is to explore whether and to what extent this transfer effect of the new land law facilitates the allocative efficiency of the rental market. This analysis first involves the recovering household's farming ability from the household's annual crop production. The estimation procedure of household fixed effects as the efficiency parameter was modeled and implemented by a number of papers such as Chamberlin and Ricker-Gilbert (2016), Deininger and Jin (2005), and Jin and Jayne (2013). Following these studies, we estimate the households' crop production on annual land with fixed effects.

The production function is written as follows:

$$y_{ht} = \alpha_0 + \alpha_1 l_{ht} + \alpha_2 n_{ht} + \alpha_3 m_{ht} + \boldsymbol{\alpha_4 X_{ht}} + \alpha_h + \alpha_t + \epsilon_{ht} \quad (3)$$

y_{ht} is logarithm of annual crop value of household h in year t. Ideally, the estimation applies for all crops that are grown on annual land. Lacking data on crop-specific inputs, the estimation relies on rice and maize crops to recover households' annual-crop farming ability. As two major crops in Vietnam, the production of both crops is separately reported including land, labor and other intermediate inputs. Two specifications are considered to represent annual crop production. One specification estimates only rice, the other includes both rice and maize.

Production is composed of input factors land (l), labor (n), and intermediate input (m) such as expenses on seeds, saplings, fertilizers, pesticides/herbicides, energy, irrigation, maintenance and other costs. Covariate vector $\boldsymbol{X_{ht}}$ represents household demographics, land quality and weather variables. Household demographics include the usual variables (household size, head's gender, educational level, age, squared age). Land controls are aggregated from plot level data, including mean distance of plots to households (log), land value, fraction of irrigation, fraction of land use restricted to certain purposes, fraction of households with usufructs of land. Land quality is self-

reported relative to commune at three levels: below, average, or above local average. Weather shocks (flood or drought) are also controlled. Land quality interacting with weather shocks generates further time-varying controls for crop outcomes. α_h and α_t are household and year fixed effects. Coefficients are estimated with fixed effects models. Households' time-invariant farming ability estimates are the household fixed effects $\widehat{\alpha_h}$ in the regression.

The relationship between the enaction of the 2013 land law (i.e., the lease extension) and the allocative efficiency of the land market is estimated with the following equation:

$$y_{ht} = \beta_0 + \beta_1 HA_h + \beta_2 T_t + \beta_3 (HA_h \cdot POST_t) + \boldsymbol{\beta_4 Z_{ht}} + \epsilon_{ht} \quad (4)$$

Outcome y_{ht} land transfer outcomes (lease out, lease in, sold, bought) of household h in year t. HA_h is the time-invariant household fixed component $\widehat{\alpha_h}$ from equation (3). The coefficient β_1 represents the extent to which land transaction is driven by total factor productivity pre-law, β_2 is the time effects. Most relevantly, the coefficient β_3 represents the difference in rental likelihood post-law specifically driven by household's technical ability. $\beta_3 = 0$ would indicate that the policy has little effect on redistributing land in a manner that would improve market efficiency. On the other hand, $\beta_3 \neq 0$ would suggest that the lease extension has an impact on reallocating land and, in turns, an impact on the annual crop outputs. Specifically, if β_3 and β_1 are of the same sign, then the policy facilitate land to be transferred and used in a more efficient way.

6.5. Estimation of impacts on labor and household food expenditures

Unlike plot transfers, employment and food expenditure are household outcomes. A modification to the difference-in-differences identification is required.

$$y_{ht} = \beta_0 + \beta_1 TREAT_{ht} + \beta_2 T_t + \beta_3 (TREAT_{ht} \cdot POST_t) + \boldsymbol{\beta_4 Z_{ht}} + \sigma_h + \epsilon_{ht} \quad (5)$$

where y_{ht} denotes outcomes for households h in year t. $y_{ht} = 1$ is a dummy variable for the household's labor choices. For this study, the employment outcomes of interest are the types of work (wage work, off-farm wage work, on farm wage work), the location of work (whether the household has any member working inside the same commune, inside the same province in another commune, and outside of the province), and whether households own a business. The welfare outcome of choice in this study is food expenditure per capita in logarithm[1].

As before, T_t is the year t fixed effect, $\boldsymbol{Z_{ht}}$ are the same households controls (household size, head's gender, educational level, age, squared age) as well as the household's lagged total annual and perennial landholding, σ_h is household fixed effect, and ϵ_{ht} is the error term for household h in year t with zero mean. The variable $POST_t$ remains the same where $POST_t = 1$ for observations after the law is implemented and 0 otherwise.

At the household level, the treatment variable is constructed to reflect households' relative annual landholdings to perennial landholdings. In the first (and preferred) set of regressions, the independent variable is defined as the ratio between annual land and total annual and perennial land. The variation in this specification comes from the proportion of land under households' ownership affected by the law. Holding total landholdings constant, the more perennial land is owned, the less affected households are, while owning more annual land places households more under the impact of the law. In order to avoid reverse causality, the treatment variable is lagged using data reported from the previous round in year $t - 2$.

[1] While the hypothesis generated by the model predicts increased income, in practice, households' income comes from many sources, it is volatile and subject to numerous factors. Meanwhile food expenditure is more stable, and its variation better reflects changes in households' welfare.

The treatment in the second specification is defined as households' lagged annual landholdings in absolute terms. Since land ownership is indicative of wealth among other things, putting the identification at higher risk of confoundment. The first treatment is the better instrument for the impact of the law while the second specification should be interpreted as a reference and a robustness check only.

7. **Results**

7.1. Impacts of the lease extension on land rental transfers

Table 6 reports the main findings of the law's impact. The first panel reports the average effects of the land law, placing observation in the pre-law group (2008-2010) and the post-law group (2014-2016). The second panel includes interactions of treatment with all years in the sample. Examining the law's impact yearly helps gain insights into the differentiation between the immediate effects as opposed to the later more gradual effects of the land law.

We find that overall, the extension of land lease by the law results in a 3 percentage point increase in the probability of a household renting out a plot. The effect is robust and increasing from 2014 to 2016. Confirming proposition 1 in section 3, the law likely allows households greater confidence and thus reduces transaction costs to leasing out, resulting in a higher likelihood of leasing out annual land.

On the other hand, the law is found to have no effect on renting in. While proposition 2 in the theoretical model predicts the likelihood of renting in land to be unaffected by a change in the transaction cost, it is expected that in equilibrium, the law would lead to an increase in both rental

supply and demand. A plausible explanation for why no effect is observed on rental demand is the sample bias. While the sample is designed to be representative of the rural population, land renters include big farms and commercial entities that are not captured by the sample. If that is the case, the finding is suggestive of additional effects of the law on another party besides the households.

Turning to the sales market, which involves the exchange of land titles, we find a strong average of 5.6 percentage point increase in the post-treatment period in the probability of annual plots being sold. Column 3 in the second panel further reports that most of the increase occurred immediately after the law was passed. There is an 8.4 percentage point increase in the probability of plots being sold in 2014, which tapers down by 2016 to a 2.6 percentage point increase. This suggests that a portion of the 2014 sales came from 2012's backlog of transactions when the market was arrested (table 5). Three years after the law was passed, in 2016, annual plot sales remain at a level higher than the pre-law period, suggesting a persistent positive effect of the law on land sales, much similar to the effect on the land rental supply.

The finding reveals no significant change in the probability of annual plots being purchased between the 2008-2010 pre-law period and after the enactment of the law. Given the drastic plunge in buying in 2012, the result may imply that buying confidence has returned to the initial level. However, the law seems to provide no additional effect on land purchasing decisions.

7.2. Results on allocative efficiency

The results of the production function regressions are reported in table A2 in the appendix for rice only and for an aggregate of rice and maize combined. Table 7 reports the marginal effects on the allocative efficiency of the law. There are two specifications, rice, and rice with maize, each using the household ability obtained from the corresponding production functions. We find that the

estimated $\widehat{\beta_1}$ is negative for columns 1 and 3, meaning households with relatively lower technical ability are more likely to lease out or sell their land. Conversely, a positive $\widehat{\beta_1}$ in column 2 means higher ability households are more likely to rent land. As hypothesized in proposition 5, this finding indicates that the rental market improves allocative efficiency by transferring land management from lower-ability to higher-ability farming households. However, technical ability does not drive the purchasing decision as seen in column 4. The significant capital investment requirement to purchase land and its ability to be used as an investment most likely contributes to the lack of explanatory power of households' ability on land purchasing decisions.

Having said that, we find little evidence that the land law marginally improves land transactions proportionally with households' farming ability. Estimates of coefficients on the interaction terms between household ability and post-law periods are consistently statistically insignificant. This implies that the effect of the law on land transactions does not depend on households' farming ability. Mathematically, returning to the model, it has been shown in the appendix that the change in land rented out due to a change in leasing out transaction cost $\frac{dL^{Out}}{dTC^{Out}} = \frac{f_{NN}}{pf_{LL}f_{NN} - pf_{LN}f_{NL}}$. Assuming a Cobb-Doughlas production function of the form $f(\alpha; L, N) = \alpha L^{\gamma} N^{\delta}$, the said effect is not a function of farming ability. Intuitively, the law has a positive effect on the land market participation rate, but the size of its effects does not depend on the household's efficiency parameter.

7.3.Impacts of the lease extension on labor and household expenditures

We report household outcomes in tables 8 and 9. As observed in columns 1-6, households' labor choices are strongly affected by the law depending on their relative holding of annual land. With more tenure security and increased confidence to rent out land, households can afford to free up

labor from time spent working on farms to supply it elsewhere. Particularly, we find that the law facilitates households with relatively more annual land to participate in the wage labor market. We also find a large statistically significant increase in work that is agriculturally related and that is located within their commune close to home. Moreover, the law is found to have no impact on the probability that households engage in non-farm jobs, and similarly no effect on households working outside of their commune or farther away, most likely since those types of work involve non-farm labor. The law seems to strictly appeal to the agricultural skill set where farming households seek jobs that they have a comparative advantage in. Column 7 also reports no effects on the likelihood of households having their own business. Nevertheless, households with a relatively higher proportion of annual land are made better off by the law, as it is associated with increased household expenditure per capita in column 8, although the effect does not have a lasting impact. When we replace the treatment variable with household absolute annual holding in table 9, the direction of effects stays consistent throughout although some results become statistically insignificant.

8. Conclusion

Land tenure security is vital to improving the efficiency of resource usage, investment, as well as allocation (Holden et al. 2010; Abdulai et al. 2011; Lawry et al. 2017; Bellemare et al. 2020). Yet it is hard to measure the effects of tenure security due to issues of endogeneity. Most of the literature focus has been on evaluating the impacts of land titling programs as an instrument for improving tenure security while neglecting less drastic policies. This study contributes to the few studies that investigate land law impacts. Methodologically, the DID estimation contributes to the

literature where endogeneity abounds, and instruments are hard to come by. It firmly establishes the causality between improved tenure security through the 2013 version of land law in Vietnam and outcomes of land, labor, and welfare.

We find that the 2013 land law increases land supply through both the rental and sales markets while detecting little effect on the demand side. By increasing households' confidence in renting and selling land, the land law lowers the market participation cost. Additionally, the study confirms that the rental market reallocates land from low-ability to high-ability households, improving overall productivity. However, the effects of the law are found to be independent of households' farming ability.

Furthermore, the effects of improved tenure security also extend to the labor market and reshape farming households' supply of labor, affecting their welfare evidenced by the increase in food expenditures. Higher security relaxes constraints on both land and labor markets to free up labor supply on households' own farms in search of other working opportunities for a wage. We found no effects on non-farm employment as well as other income opportunities through businesses owned by households. In short, these findings show that the land law is effective in improving land market participation and household expenditure. However, its effect on increasing labor supply is limited to the agricultural skillset.

Given the findings in this paper, land law could be a cost-effective way of improving tenure security, especially in countries constrained by financial resources. However, to maximize the full potential of the law's impacts, other complementary policies might be needed. Policies that improve opportunities for non-farm jobs and borrowing capital can generate a greater impact on rural economies and should be considered.

There are certain caveats to this study. One limitation of the analysis is that methodologically, the study, unfortunately, cannot perform true DID analysis on the household outcomes. The study cannot provide a more complete impact evaluation of the law on the demand for land, given the lack of information on the other agricultural producers besides households. Another limitation is that the identified effects of the land law is relatively short-term. Future research should utilize more appropriate data to examine longer term impacts of the land law.

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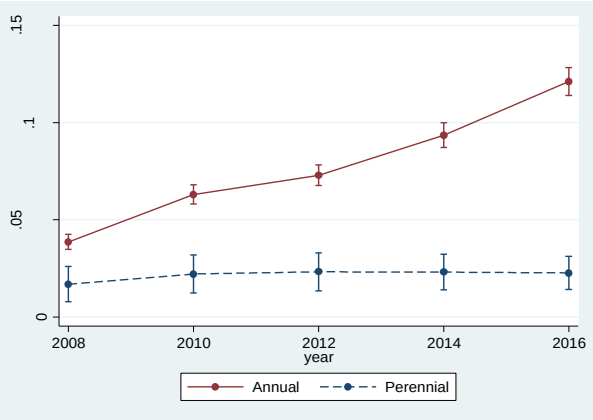
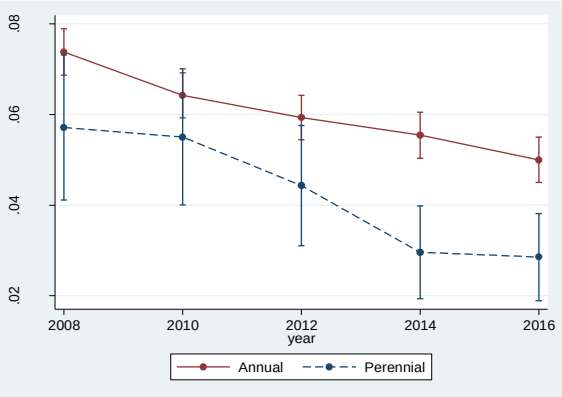
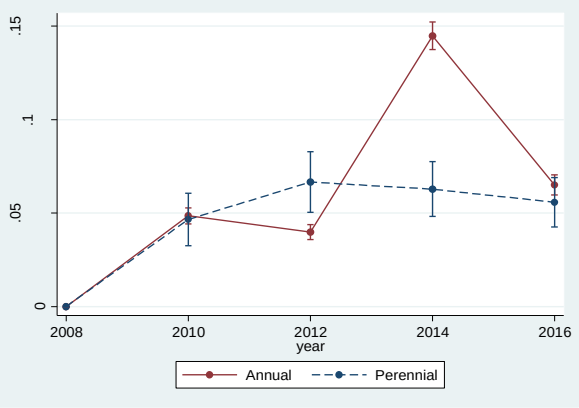
Figure 1: Land transaction trends by year







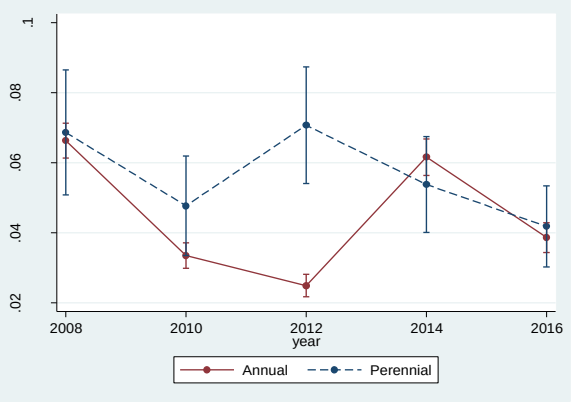


Table 1: Balanced vs. Unbalanced

	Balanced
Female head	-0.0152
	(0.0158)
Head's education	0.00826
	(0.0120)
Head's age	-0.000470
	(0.000858)
Household size	0.00665**
	(0.00248)
Annual landholding size	0.00888**
	(0.00338)
Annual and perennial landholding size	0.000203
	(0.00356)
Constant	0.784***
	(0.0542)
Observations	3,267
R-squared	0.012

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Household characteristics by land types

	Perennial	Annual	Difference
Female head	0.104	0.149	-0.044
	(0.0043)	(0.0016)	(0.0051)
Head's education	1.284	1.198	0.086
	(0.0139)	(0.0045)	(0.0145)
Head's age	47.877	51.247	-3.370
	(0.1621)	(0.0566)	(0.1825)
Household size	5.036	4.845	0.191
	(0.0255)	(0.0088)	(0.0283)
Household values of durable goods	2,000.478	1,092.652	907.8255
	(168.1769)	(89.1414)	(291.7778)
Plot area	7,349.429	1,695.186	5,654.238
	(127.5354)	(29.0624)	(98.8452)
Distance from plots	3,797.306	1,468.576	2,328.730
	(411.4919)	(23.7024)	(151.9553)
Plot quality	1.932	1.941	-0.009

	(0.0054)	(0.0016)	(0.0053)
Observations	5,158	49,269	

Standard errors are in parentheses.

Table 3: Land transactions by land types

	Perennial	Annual	Difference
Rented Out	0.022	0.076	0.054
	(0.0021)	(0.0013)	(0.0039)
Rented In	0.041	0.061	0.020
	(0.0029)	(0.0012)	(0.0036)
Sold	0.049	0.059	0.010
	(0.0032)	(0.0011)	(0.0036)
Purchased	0.055	0.045	-0.011
	(0.0033)	(0.0010)	(0.0032)

Standard errors are in parentheses.

Table 4: Sample's household outcomes in fraction by year

Year	Wage labor	Nonfarm wage labor	Farm wage labor	Wage labor in commune	Wage labor in province	Wage labor outside of province	Own Business	Food Expenditure per capita
2008	0.50827	0.39846	0.15269	0.31962	0.16269	0.10769	0.2077	$134.21
2010	0.56851	0.44303	0.17937	0.38645	0.18476	0.0689	0.2623	$140.23
2012	0.60039	0.46346	0.18923	0.42538	0.21385	0.045	0.2508	$175.21
2014	0.67077	0.43846	0.30923	0.51115	0.20308	0.06769	0.1996	$167.13
2016	0.67423	0.45654	0.30808	0.50231	0.22192	0.08885	0.2462	$181.39

Table 5: Pre-trend tests

	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased
Annual x Year 2008	-0.0103	0.00572	-0.00374	0.00840
	(0.00822)	(0.0075)	(0.0105)	(0.0183)
Annual x Year 2012	0.00738	0.000840	-0.0262**	-0.0258**
	(0.00772)	(0.0075)	(0.0119)	(0.0114)
Year 2008	-0.0130*	0.00145	-0.0420***	0.0253
	(0.00693)	(0.0068)	(0.0103)	(0.0161)
Year 2012	0.00680	-0.00431	0.0274**	0.0181*
	(0.00682)	(0.0069)	(0.0115)	(0.0108)
Annual	0.0327***	0.0334**	0.00316	0.00537
	(0.00900)	(0.0144)	(0.0105)	(0.0134)
Observations	30,544	30,870	30,145	30,544
R-squared	0.528	0.357	0.237	0.237

Note: Control is included throughout but coefficients that are not reported include, plot land quality, household head's gender, age, squared age, education, and household size, distance between plot and home, log of plot area, dummy for average quality plot, and dummy for above average quality plot. Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 6: Impacts of law on land transactions

	Post-law vs Pre-law				By individual year			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Rented Out	Rented In	Sold	Purchased	Rented Out	Rented In	Sold	Purchased
Annual x Post-law	0.0338***	0.00388	0.0558***	0.0233				
	(0.00922)	(0.00912)	(0.0172)	(0.0158)				
Annual x Year 2008					-0.0125	0.00453	-0.00355	0.00808
					(0.00888)	(0.00783)	(0.0106)	(0.0183)
Annual x Year 2014					0.0203**	0.00501	0.0841***	0.0303
					(0.00987)	(0.00945)	(0.0265)	(0.0186)
Annual x Year 2016					0.0351***	0.00695	0.0255*	0.0239
					(0.0109)	(0.00996)	(0.0154)	(0.0151)
Annual	0.0193*	0.035***	-0.0297***	-0.00446	0.0250**	0.0329**	-0.0274**	-0.00821
	(0.0100)	(0.0124)	(0.0110)	(0.0107)	(0.0103)	(0.0131)	(0.0132)	(0.0109)
Year 2008	-0.025***	0.00580*	-0.045***	0.0327***	-0.0133*	0.00163	-0.042***	0.0252
	(0.00507)	(0.00317)	(0.00821)	(0.0112)	(0.00763)	(0.00727)	(0.0104)	(0.0160)
Year 2014	0.00136	-0.00956	0.0438***	0.0118	0.0134*	-0.0106	0.0184	0.00547
	(0.00789)	(0.00860)	(0.0131)	(0.0113)	(0.00775)	(0.00908)	(0.0117)	(0.0130)
Year 2016	0.0198**	-0.0125	-0.00861	-0.0107	0.0189**	-0.0152	0.0178	-0.0114
	(0.00802)	(0.00867)	(0.0134)	(0.0117)	(0.00846)	(0.00955)	(0.0118)	(0.0120)
Mean	0.0708	0.0598	0.0625	0.0504	0.0708	0.0598	0.0625	0.0504
	(0.0013)	(0.0012)	(0.0012)	(0.0011)	(0.0013)	(0.0012)	(0.0012)	(0.0011)
Observations	38,573	38,122	39,072	38,573	38,573	38,122	39,072	38,573
R-squared	0.480	0.328	0.257	0.185	0.480	0.328	0.258	0.185

Note: Control is included throughout but coefficients that are not reported include, plot land quality, household head's gender, age, squared age, education, and household size, distance between plot and home, log of plot area, dummy for average quality plot, and

dummy for above average quality plot. Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 7: Marginal effects on allocative efficiency of the law

	Post-law vs Pre-law							
	Rice				Rice and Maize			
	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased
HA x Post-law	-0.0152	-0.0281	0.00702	-0.000491	-0.0122	-0.0327	0.0199	0.0550
	(0.0172)	(0.0224)	(0.0202)	(0.0303)	(0.0163)	(0.0211)	(0.0156)	(0.0350)
HA	-0.043***	0.0619*	-0.0236**	0.0152	-0.050***	0.0706**	-0.0279***	-0.0454
	(0.0157)	(0.0333)	(0.0109)	(0.0264)	(0.0166)	(0.0331)	(0.00987)	(0.0288)
Year 2008	-0.023***	0.0270***	-0.0895***	0.0501***	-0.023***	0.0270***	-0.0895***	0.0505***
	(0.00600)	(0.00810)	(0.00982)	(0.0178)	(0.00602)	(0.00810)	(0.00983)	(0.0179)
Year 2014	0.0120	-0.027***	0.0697***	0.0118	0.0116	-0.026***	0.0692***	0.00992
	(0.00925)	(0.00790)	(0.0183)	(0.0217)	(0.00929)	(0.00791)	(0.0183)	(0.0218)
Year 2016	0.0302***	-0.051***	-0.0130	-0.0381**	0.0295***	-0.0497***	-0.0136	-0.0402**
	(0.0107)	(0.00927)	(0.0132)	(0.0158)	(0.0108)	(0.00930)	(0.0132)	(0.0159)
Mean	0.1150	0.1347	0.0926	0.1497	0.1150	0.1347	0.0926	0.1497
	(0.0033)	(0.0035)	(0.0030)	(0.0037)	(0.0033)	(0.0035)	(0.0030)	(0.0037)
Observations	9,291	9,291	9,367	9,367	9,291	9,291	9,367	9,367
R-squared	0.107	0.032	0.065	0.023	0.109	0.034	0.065	0.024

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, and household size. Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 7 (cont.)

	By individual year							
	Rice				Rice and Maize			
	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased
HA x Year 2008	0.0102	0.0420**	0.0243	0.0199	0.00621	0.0269	0.0185	-0.0373
	(0.0175)	(0.0201)	(0.0192)	(0.0372)	(0.0155)	(0.0174)	(0.0173)	(0.0354)
HA x Year 2014	-0.0190	-0.00436	0.0289	-2.87e-05	-0.0209	-0.0150	0.0327	0.0359
	(0.0193)	(0.0211)	(0.0343)	(0.0440)	(0.0184)	(0.0181)	(0.0272)	(0.0444)
HA x Year 2016	-0.00124	-0.0104	0.00895	0.0187	0.00292	-0.0236	0.0254	0.0370
	(0.0270)	(0.0250)	(0.0244)	(0.0375)	(0.0256)	(0.0230)	(0.0216)	(0.0344)
HA	-0.0481**	0.0412	-0.0355*	0.00544	-0.0532**	0.0572*	-0.0371**	-0.0268
	(0.0212)	(0.0340)	(0.0198)	(0.0332)	(0.0222)	(0.0323)	(0.0178)	(0.0312)
Year 2008	-0.0237***	0.0262***	-0.0900***	0.0497***	-0.0235***	0.0262***	-0.0900***	0.0515***
	(0.00604)	(0.00812)	(0.00993)	(0.0179)	(0.00606)	(0.00804)	(0.0101)	(0.0178)
Year 2014	0.0121	-0.027***	0.0693***	0.0119	0.0120	-0.0265***	0.0688***	0.0104
	(0.00927)	(0.00789)	(0.0182)	(0.0215)	(0.00929)	(0.00790)	(0.0183)	(0.0217)
Year 2016	0.0299***	-0.051***	-0.0129	-0.0385**	0.0290***	-0.0499***	-0.0137	-0.0398**
	(0.0106)	(0.00932)	(0.0132)	(0.0159)	(0.0106)	(0.00937)	(0.0133)	(0.0159)
Mean	0.1150	0.1347	0.0926	0.1497	0.1150	0.1347	0.0926	0.1497
	(0.0033)	(0.0035)	(0.0030)	(0.0037)	(0.0033)	(0.0035)	(0.0030)	(0.0037)
Observations	9,291	9,291	9,367	9,367	9,291	9,291	9,367	9,367
R-squared	0.107	0.032	0.065	0.023	0.109	0.034	0.065	0.024

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, and household size. Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 8: Impacts of law on household outcomes using Lagged Annual Ratio

	Post-law vs Pre-law							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment is Lagged Annual Ratio	Wage Labor	Nonfarm Wage Labor	Farm Wage Labor	Wage Labor in Commune	Wage Labor in Province	Wage Labor Outside of Province	Owned Business	Food Expenditure Per Capita
Lagged Annual Ratio x Post Law	0.111***	0.0142	0.141***	0.136***	-0.00139	0.0304	0.0133	0.128*
	(0.0360)	(0.0375)	(0.0484)	(0.0458)	(0.0274)	(0.0235)	(0.0460)	(0.0718)
Lagged Annual Ratio	-0.0798	-0.0193	-0.107*	-0.102*	0.0103	-0.00699	-0.0805*	-0.147*
	(0.0486)	(0.0463)	(0.0588)	(0.0610)	(0.0433)	(0.0238)	(0.0421)	(0.0773)
Year 2014	0.0321	-0.00523	0.0164	0.0212	0.0184	-0.0250	-0.0836**	0.0138
	(0.0330)	(0.0326)	(0.0407)	(0.0416)	(0.0235)	(0.0211)	(0.0329)	(0.0679)
Year 2016	0.0520	0.0999*	0.0967	0.144**	0.0453	0.0201	-0.00441	0.387***
	(0.0337)	(0.0515)	(0.0634)	(0.0686)	(0.0390)	(0.0314)	(0.0621)	(0.0926)
Mean	0.6055	0.4341	0.2374	0.4299	0.1931	0.0833	0.229	4.71
	(0.0048)	(0.0049)	(0.0042)	(0.0049)	(0.0039)	(0.0027)	(0.0041)	(0.0089)
Observations	7,795	7,795	7,795	7,795	7,795	7,795	7,797	7,797
R-squared	0.539	0.608	0.524	0.505	0.525	0.437	0.567	0.667

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, household size, and lagged annual and perennial landholdings (log). Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 8 (cont.)

	By individual years							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment is Lagged Annual Ratio	Wage Labor	Nonfarm Wage Labor	Farm Wage Labor	Wage Labor in Commune	Wage Labor in Province	Wage Labor Outside of Province	Owned Business	Food Expenditure Per Capita
Lagged Annual Ratio x Year 2014	0.133***	0.0345	0.129**	0.154***	0.00498	0.0181	-0.00564	0.189**
	(0.0510)	(0.0385)	(0.0527)	(0.0512)	(0.0318)	(0.0270)	(0.0398)	(0.0891)
Lagged Annual Ratio x Year 2016	0.0907*	0.00517	0.162***	0.136***	-0.00662	0.0447	0.0358	0.116
	(0.0521)	(0.0434)	(0.0527)	(0.0492)	(0.0315)	(0.0276)	(0.0631)	(0.0774)
Lagged Annual Ratio	-0.0778	-0.0205	-0.113*	-0.106*	0.0112	-0.00892	-0.0849**	-0.162**
	(0.0605)	(0.0460)	(0.0595)	(0.0607)	(0.0438)	(0.0238)	(0.0431)	(0.0792)
Year 2014	0.0145	-0.0128	0.0331	0.0198	0.0143	-0.0128	-0.0653**	0.000223
	(0.0433)	(0.0329)	(0.0418)	(0.0422)	(0.0261)	(0.0234)	(0.0276)	(0.0840)
Year 2016	0.0682	0.0403	0.0146	0.0409	0.0446*	-0.00958	-0.0549*	0.0835
	(0.0469)	(0.0371)	(0.0422)	(0.0453)	(0.0268)	(0.0233)	(0.0317)	(0.0652)
Mean	0.6055	0.4341	0.2374	0.4299	0.1931	0.0833	0.229	4.71
	(0.0048)	(0.0049)	(0.0042)	(0.0049)	(0.0039)	(0.0027)	(0.0041)	(0.0089)
Observations	7,795	7,795	7,795	7,795	7,795	7,795	7,797	7,797
R-squared	0.539	0.607	0.524	0.504	0.525	0.437	0.567	0.662

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, household size, and lagged annual and perennial landholdings (log). Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 9: Impacts of law on household outcomes using Log Lagged Annual Area

	Post-law vs Pre-law							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment is Lagged Annual Area (Log)	Wage Labor	Nonfarm Wage Labor	Farm Wage Labor	Wage Labor in Commune	Wage Labor in Province	Wage Labor Outside of Province	Owned Business	Food Expenditure Per Capita
Lagged Annual Area x Post Law	0.0233***	1.89e-05	0.0290***	0.0243***	-0.00132	0.00608**	-0.00315	0.00424
	(0.00629)	(0.00446)	(0.00744)	(0.00572)	(0.00365)	(0.00288)	(0.00744)	(0.0107)
Lagged Annual Area	-0.0138*	0.00696	-0.0253***	-0.0200***	0.00740	-0.00382	-0.00350	-0.00240
	(0.00785)	(0.00623)	(0.00720)	(0.00692)	(0.00455)	(0.00274)	(0.00575)	(0.0111)
Year 2014	-0.0461	0.0159	-0.0729*	-0.0313	0.0282	-0.0423*	-0.0449	0.126
	(0.0382)	(0.0348)	(0.0405)	(0.0357)	(0.0291)	(0.0240)	(0.0470)	(0.0778)
Year 2016	-0.0255	0.0468	-0.0648	-0.0245	0.0499*	-0.0182	-0.00130	0.152**
	(0.0393)	(0.0347)	(0.0411)	(0.0382)	(0.0298)	(0.0207)	(0.0353)	(0.0709)
Mean	0.6055	0.4341	0.2374	0.4299	0.1931	0.0833	0.229	4.71
	(0.0048)	(0.0049)	(0.0042)	(0.0049)	(0.0039)	(0.0027)	(0.0041)	(0.0089)
Observations	7,795	7,795	7,795	7,795	7,795	7,795	7,797	7,797
R-squared	0.541	0.607	0.527	0.505	0.525	0.437	0.566	0.661

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, household size, and lagged annual and perennial landholdings (log). Standard errors are clustered at the commune level. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 9 (cont.):

Treatment is Lagged Annual Area (Log)	By individual years							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Wage Labor	Nonfarm Wage Labor	Farm Wage Labor	Wage Labor in Commune	Wage Labor in Province	Wage Labor Outside of Province	Owned Business	Food Expenditure Per Capita
Lagged Annual	0.0245***	0.000249	0.0249***	0.0248***	-0.000502	0.00189	-0.00907	0.0130
Area x Year 2014	(0.00698)	(0.00477)	(0.00809)	(0.00710)	(0.00443)	(0.00327)	(0.00582)	(0.0120)
Lagged Annual	0.0221***	-0.000195	0.0328***	0.0238***	-0.00208	0.00997***	0.00235	-0.00388
Area x Year 2016	(0.00690)	(0.00529)	(0.00780)	(0.00591)	(0.00378)	(0.00358)	(0.0101)	(0.0112)
Lagged Annual	-0.0137*	0.00698	-0.0256***	-0.0199***	0.00747	-0.00419	-0.00403	-0.00161
Area	(0.00785)	(0.00624)	(0.00716)	(0.00691)	(0.00455)	(0.00279)	(0.00583)	(0.0111)
Year 2014	-0.0552	0.0142	-0.0436	-0.0350	0.0223	-0.0121	-0.00215	0.0627
	(0.0411)	(0.0371)	(0.0432)	(0.0424)	(0.0349)	(0.0265)	(0.0373)	(0.0882)
Year 2016	-0.0173	0.0483	-0.0915**	-0.0212	0.0552*	-0.0456**	-0.0400	0.209***
	(0.0440)	(0.0379)	(0.0425)	(0.0412)	(0.0292)	(0.0224)	(0.0478)	(0.0735)
Mean	0.6055	0.4341	0.2374	0.4299	0.1931	0.0833	0.229	4.71
	(0.0048)	(0.0049)	(0.0042)	(0.0049)	(0.0039)	(0.0027)	(0.0041)	(0.0089)
Observations	7,795	7,795	7,795	7,795	7,795	7,795	7,797	7,797
R-squared	0.541	0.607	0.528	0.505	0.525	0.438	0.567	0.662

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, household size, and lagged annual and perennial landholdings (log). Standard errors are clustered at the commune level.. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Appendix

A1. Comparative statics for the household problem

$$V = \max_{L^{Out}, L^{In}, N^{In}} pf\left(\alpha;\ \overline{L} - L^{Out} + L^{In}, \overline{N} - N^{Out}\ \right) + (r - TC^{Out})L^{Out} - (r + TC^{In})L^{In} + wN^{Out}$$

FOC: $pf_L = r - TC^{Out}$ or $pf_L = r + TC^{In}$ (FOC1)

and $pf_N = w$ (FOC2)

L^{Out} and L^{In} cannot be simultaneously positive if a nonzero transaction cost exists since then $pf_L = r - TC^{Out} = r + TC^{In}$, which can only be true if $TC^{Out} = TC^{In} = 0$.

If $L^{Out} > 0$, then $L^{In} = 0$. When $L^{In} = 0, \frac{dL^{In}}{dTC^{Out}} = 0$ (Proposition 2).

Total derivative of the FOC with respect to TC^{Out} yields

FOC2: $-pf_{NL}\frac{dL^{Out}}{dTC^{Out}} - p\, f_{NN}\frac{dN^{Out}}{dTC^{Out}} = 0 \Longrightarrow \frac{dL^{Out}}{dTC^{Out}}\frac{dN^{Out}}{dTC^{Out}} > 0$ given $f_{NL} > 0$ and $f_{NN} < 0$.

Also, $\frac{dN^{Out}}{dTC^{Out}} = \frac{-f_{NL}}{f_{NN}}\frac{dL^{Out}}{dTC^{Out}}$

FOC1: $-pf_{LL}\frac{dL^{Out}}{dTC^{Out}} - p\, f_{LN}\frac{dN^{Out}}{dTC^{Out}} = -1 \Longrightarrow \frac{dL^{Out}}{dTC^{Out}}\left(\frac{-pf_{LL}f_{NN} + pf_{LN}f_{NL}}{f_{NN}}\right) = -1$

$\Longrightarrow \frac{dL^{Out}}{dTC^{Out}} < 0$ (Proposition 1) and $\frac{dN^{Out}}{dTC^{Out}} < 0$ (Proposition 3).

In equilibrium, however, an increase in supply of land being rented out leads to a lower rental price and leads to a higher amount of land rented in so that in equilibrium demand is equal to supply (Proposition 3).

Furthermore, the total derivative of the household income to transaction cost TC^{Out} yields:

$\frac{dV}{dTC^{Out}} = -L^{Out} - TC^{Out}\frac{dL^{Out}}{dTC^{Out}} + w\frac{dN^{Out}}{dTC^{Out}} < 0$ (Proposition 4).

A2. Production function of household major annual crops

	(1) Rice	(2) Rice & Maize
Area (Log)	0.419***	0.609***
	(0.0648)	(0.0243)
Labor Days (Log)	0.0791***	0.110***
	(0.0171)	(0.0207)
Intermediate Input (Log)	0.251***	-0.000999
	(0.0545)	(0.00168)
Year 2010	-0.189***	-0.139***
	(0.0276)	(0.0253)
Year 2012	-0.261***	-0.156***
	(0.0340)	(0.0241)
Year 2014	-0.290***	-0.126***
	(0.0477)	(0.0238)
Year 2016	-0.292***	-0.160***
	(0.0486)	(0.0337)
Female Head	0.0574	-0.00636
	(0.0389)	(0.0324)
Head's Education	0.00323	-0.00648
	(0.0135)	(0.0128)
Head's Age	-0.00671	-0.00202
	(0.00531)	(0.00515)
Head's Age Squared	5.12e-05	1.09e-05
	(4.80e-05)	(4.64e-05)
Household Size	0.0184***	0.0186***
	(0.00456)	(0.00488)
Land Distance from Household (Log)	0.0149***	0.0312***
	(0.00522)	(0.00690)
Land Value (Log)	-0.00369*	-0.00402**
	(0.00194)	(0.00187)
Irrigation Fraction	0.0638**	0.133***
	(0.0273)	(0.0276)
Restricted Purpose Land Fraction	0.00304	0.00527
	(0.0143)	(0.0147)
LURC Fraction	-0.0430*	-0.0372
	(0.0244)	(0.0283)
Below average land quality	-0.00913	0.00608
	(0.0179)	(0.0220)
Average land quality	0.0347	0.0602
	(0.0318)	(0.0396)

Above average land quality	0.0496**	0.0468**
	(0.0243)	(0.0232)
Missing land quality	0.172	0.151
	(0.144)	(0.138)
Flood/Drought x Below average land quality	-0.0199	-0.0264
	(0.0356)	(0.0358)
Flood/Drought x Average land quality	-0.0774***	-0.0591**
	(0.0202)	(0.0235)
Flood/Drought x Above average land	-0.0690	-0.0330
	(0.0511)	(0.0552)
Flood/Drought x Missing Land Quality	-0.441	-0.291
	(0.297)	(0.339)
Constant	0.397***	0.230
	(0.150)	(0.152)
Observations	12,996	12,996
R-squared	0.901	0.891
Number of hhid	2,600	2,600

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A3. Land transactions including all years

	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased
Annual x Year 2008	-0.0118	0.00604	-0.00518	0.00780
	(0.00871)	(0.00747)	(0.0103)	(0.0180)
Annual x Year 2012	0.00621	0.000157	-0.0268**	-0.0265**
	(0.00775)	(0.00779)	(0.0119)	(0.0107)
Annual x Year 2014	0.0219**	0.00535	0.0809***	0.0296
	(0.00985)	(0.00955)	(0.0261)	(0.0180)
Annual x Year 2016	0.0367***	0.00696	0.0171	0.0238
	(0.0109)	(0.0100)	(0.0150)	(0.0148)
Annual	0.0266***	0.0328**	-0.0144	-0.00234
	(0.00976)	(0.0132)	(0.0118)	(0.0101)
Year 2008	-0.0139*	0.000985	-0.0397***	0.0255
	(0.00752)	(0.00682)	(0.00997)	(0.0159)
Year 2012	0.00878	-0.00493	0.0250**	0.0186*
	(0.00714)	(0.00725)	(0.0114)	(0.0101)
Year 2014	0.0134*	-0.0111	0.0246**	0.00366
	(0.00771)	(0.00912)	(0.0115)	(0.0126)
Year 2016	0.0192**	-0.0157	0.0221*	-0.0135
	(0.00821)	(0.00962)	(0.0116)	(0.0116)
Observations	48,642	48,079	49,280	48,642
R-squared	0.483	0.325	0.205	0.152

Note: Control is included throughout but coefficients that are not reported include, plot land quality, household head's gender, age, squared age, education, and household size, distance between plot and home, log of plot area, dummy for average quality plot, and dummy for above average quality plot. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

A4. Household outcomes using Log Lagged Annual Ratio including all years

Treatment is Lagged Annual Ratio	(1) Wage Labor	(2) Nonfarm Wage Labor	(3) Farm Wage Labor	(4) Wage Labor in Commune	(5) Wage Labor in Province	(6) Wage Labor Outside of Province	(7) Owned Business	(8) Food Expenditure Per Capita
Lagged Annual	0.0366	0.00992	0.0525	0.0641	-0.00756	-0.00270	0.0110	0.0267
Ratio x Y2012	(0.0449)	(0.0380)	(0.0461)	(0.0479)	(0.0283)	(0.0201)	(0.0334)	(0.0562)
Lagged Annual	0.131***	0.0212	0.138***	0.163***	-0.00549	0.0108	-0.00647	0.188**
Ratio x Y2014	(0.0474)	(0.0359)	(0.0477)	(0.0463)	(0.0303)	(0.0247)	(0.0370)	(0.0792)
Lagged Annual	0.0763	-0.00682	0.156***	0.136***	-0.0230	0.0368	0.0372	0.109
Ratio x Y2016	(0.0467)	(0.0400)	(0.0465)	(0.0439)	(0.0292)	(0.0255)	(0.0587)	(0.0695)
Lagged Annual	-0.0438	0.000768	-0.0963**	-0.0841*	0.0182	0.00534	-0.0635*	-0.150**
Ratio	(0.0441)	(0.0347)	(0.0410)	(0.0437)	(0.0322)	(0.0191)	(0.0332)	(0.0586)
Year 2012	0.0105	0.0220	-0.0313	-0.00822	0.0373	-0.0200	-0.0217	0.213***
	(0.0413)	(0.0318)	(0.0465)	(0.0442)	(0.0236)	(0.0176)	(0.0275)	(0.0463)
Year 2014	0.0187	-0.00161	0.0273	0.00915	0.0265	-0.00552	-0.0604**	0.00155
	(0.0402)	(0.0308)	(0.0363)	(0.0379)	(0.0254)	(0.0212)	(0.0256)	(0.0747)
Year 2016	0.0831**	0.0510	0.0221	0.0358	0.0629**	-0.00114	-0.0497*	0.0904
	(0.0422)	(0.0344)	(0.0365)	(0.0403)	(0.0251)	(0.0211)	(0.0295)	(0.0582)
Observations	10,395	10,395	10,395	10,395	10,395	10,395	10,397	10,397
R-squared	0.493	0.564	0.462	0.438	0.468	0.375	0.532	0.636

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, and household size. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

A5. Household outcomes using Log Lagged Annual Area including all years

Treatment is Log Lagged Annual Area	(1) Wage Labor	(2) Nonfarm Wage Labor	(3) Farm Wage Labor	(4) Wage Labor in Commune	(5) Wage Labor in Province	(6) Wage Labor Outside of Province	(7) Owned Business	(8) Food Expenditure Per Capita
Lagged Annual Area (log)x2012	0.00717	-0.00142	0.0111**	0.00856*	-0.00191	0.00239	-0.00155	0.000204
	(0.00485)	(0.00451)	(0.00513)	(0.00484)	(0.00356)	(0.00284)	(0.00450)	(0.00786)
Lagged Annual Area (log)x2014	0.0242***	-0.000604	0.0256***	0.0256***	-0.00130	0.00135	-0.00865	0.0140
	(0.00650)	(0.00450)	(0.00732)	(0.00636)	(0.00405)	(0.00307)	(0.00525)	(0.0105)
Lagged Annual Area (log)x2016	0.0211***	-0.000819	0.0320***	0.0239***	-0.00341	0.00938***	0.00271	-0.00378
	(0.00634)	(0.00499)	(0.00697)	(0.00532)	(0.00346)	(0.00331)	(0.00921)	(0.0101)
Lagged Annual Area (log)	-0.0104**	0.00407	-0.0188***	-0.0149***	0.00477	-0.000854	-0.00270	-0.00441
	(0.00526)	(0.00427)	(0.00492)	(0.00476)	(0.00359)	(0.00229)	(0.00463)	(0.00783)
Year 2012	-0.0119	0.0408	-0.0690*	-0.0179	0.0452	-0.0397*	-0.000390	0.237***
	(0.0364)	(0.0338)	(0.0383)	(0.0376)	(0.0280)	(0.0227)	(0.0316)	(0.0572)
Year 2014	-0.0509	0.0203	-0.0462	-0.0446	0.0315	-0.00684	-0.00134	0.0559
	(0.0393)	(0.0353)	(0.0376)	(0.0379)	(0.0322)	(0.0248)	(0.0336)	(0.0769)
Year 2016	-0.00691	0.0528	-0.0825**	-0.0269	0.0695***	-0.0391*	-0.0369	0.210***
	(0.0409)	(0.0362)	(0.0357)	(0.0364)	(0.0268)	(0.0207)	(0.0436)	(0.0650)
Observations	10,395	10,395	10,395	10,395	10,395	10,395	10,397	10,397
R-squared	0.495	0.564	0.465	0.440	0.468	0.377	0.533	0.635

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, and household size. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

A6. Marginal effects on allocative efficiency including all years

	Rice				Rice and Maize			
	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased	(1) Rented Out	(2) Rented In	(3) Sold	(4) Purchased
HA x Year 2008	0.0101	0.0420**	0.0244	0.0203	0.00623	0.0269	0.0185	-0.0373
	(0.0175)	(0.0201)	(0.0192)	(0.0373)	(0.0156)	(0.0174)	(0.0173)	(0.0355)
HA x Year 2012	0.00239	0.0104	-0.0193	0.00364	0.00315	-0.00290	-0.00868	0.0562*
	(0.0139)	(0.0194)	(0.0235)	(0.0306)	(0.0121)	(0.0165)	(0.0237)	(0.0302)
HA x Year 2014	-0.0190	-0.00436	0.0286	-5.69e-05	-0.0209	-0.0149	0.0325	0.0359
	(0.0193)	(0.0211)	(0.0343)	(0.0440)	(0.0185)	(0.0181)	(0.0272)	(0.0445)
HA x Year 2016	-0.00111	-0.0104	0.00857	0.0188	0.00304	-0.0235	0.0251	0.0371
	(0.0270)	(0.0250)	(0.0244)	(0.0375)	(0.0256)	(0.0229)	(0.0216)	(0.0344)
Year 2008	-0.023***	0.0262***	-0.0902***	0.0491***	-0.023***	0.0263***	-0.0902***	0.0508***
	(0.00602)	(0.00812)	(0.00995)	(0.0180)	(0.00604)	(0.00804)	(0.0101)	(0.0179)
Year 2012	0.00390	-0.0111*	-0.00662	-0.0251*	0.00370	-0.0106*	-0.00682	-0.0267**
	(0.00693)	(0.00589)	(0.0110)	(0.0128)	(0.00698)	(0.00586)	(0.0111)	(0.0128)
Year 2014	0.0119	-0.027***	0.0692***	0.0129	0.0117	-0.026***	0.0687***	0.0116
	(0.00927)	(0.00793)	(0.0183)	(0.0217)	(0.00928)	(0.00794)	(0.0183)	(0.0218)
Year 2016	0.0294***	-0.0508***	-0.0130	-0.0369**	0.0285***	-0.0496***	-0.0138	-0.0378**
	(0.0107)	(0.00931)	(0.0133)	(0.0161)	(0.0107)	(0.00936)	(0.0133)	(0.0162)
HA	-0.0489**	0.0406	-0.0352*	0.00642	-0.0541**	0.0570*	-0.0365**	-0.0248
	(0.0212)	(0.0339)	(0.0197)	(0.0332)	(0.0224)	(0.0323)	(0.0176)	(0.0312)
Observations	11,622	11,622	11,720	11,720	11,622	11,622	11,720	11,720
R-squared	0.106	0.031	0.056	0.023	0.107	0.032	0.056	0.024

Note: Control is included throughout but coefficients that are not reported include, household head's gender, age, squared age, education, and household size. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.